Europäisches Patentamt

European Patent Office

Office européen des brevets

# Bescheinigung

# Certificate

# Attestation

Die angehefteten Unterlagen stimmen mit der ursprünglich eingereichten Fassung der auf dem nächsten Blatt bezeichneten europäischen Patentanmeldung überein.

The attached documents are exact copies of the European patent application described on the following page, as originally filed.

Les documents fixés à cette attestation sont conformes à la version initialement déposée de la demande de brevet européen spécifiée à la page suivante.

**Patentanmeldung Nr.** **Patent application No.** **Demande de brevet n°**

03006874.6

Der Präsident des Europäischen Patentamts;
Im Auftrag

For the President of the European Patent Office

Le Président de l'Office européen des brevets
p.o.

**R C van Dijk**

Anmeldung Nr:
Application no.: 03006874.6
Demande no:

Anmeldetag:
Date of filing: 28.03.03
Date de dépôt:

Anmelder/Applicant(s)/Demandeur(s):

adidas International B.V.
Koningin Wilhelminaplein 30
1062 KR Amsterdam
PAYS-BAS

Bezeichnung der Erfindung/Title of the invention/Titre de l'invention:
(Falls die Bezeichnung der Erfindung nicht angegeben ist, siehe Beschreibung.
If no title is shown please refer to the description.
Si aucun titre n'est indiqué se referer à la description.)

Shoe sole

In Anspruch genommene Prioriät(en) / Priority(ies) claimed /Priorité(s) revendiquée(s)
Staat/Tag/Aktenzeichen/State/Date/File no./Pays/Date/Numéro de dépôt:

DE/31.07.02/DE 10234913

Internationale Patentklassifikation/International Patent Classification/ Classification internationale des brevets:

A43B/

Am Anmeldetag benannte Vertragstaaten/Contracting states designated at date of filing/Etats contractants désignées lors du dépôt:

AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC
NL PT RO SE SI SK TR

March 28, 2003

adidas International Marketing B.V. ADI37832EP HS/Wg/tge

# Shoe sole

## 1. Technical field

The present invention relates to a shoe sole of a shoe, in particular a sports shoe.

## 2. The prior art

Shoe soles have to meet two main requirements. On the one hand they should provide a good grip on the ground, on the other hand they should sufficiently cushion the ground reaction forces occurring during a step cycle to reduce the strains on the muscles and the bones.

In traditional shoe manufacturing the first objective is addressed by the outsole, whereas a midsole is arranged on top of the outsole for cushioning. In sports shoes, but also in other shoes which are subjected to substantial loads the midsole is typically homogeneously formed from foamed EVA (ethylene vinyl acetate).

A more detailed research concerning the biomechanical processes during running, however, has shown that a homogeneously formed midsole is not sufficient for the complex processes during a step cycle. The course of motion starting from the ground contact with the heel until push-off with the toe area is a three-dimensional movement including a plurality of complex rotations of the foot from the lateral to the medial side and vice versa.

In order to better control this course of motion it was therefore suggested in the prior art to arrange instead of the homogenous midsole separate cushioning elements in certain parts of the sole, which selectively influence the above mentioned course of motion during the phases of a step cycle.

An example of such a sole construction can be found in the DE 101 12 821 of applicant of the present patent application. The heel area of the shoe disclosed in this document comprises several separate deformation elements having different degrees of hardness, which bring the foot during ground contact with the heel into a correct position for the subsequent rolling-off and pushing-off phases. The deformation elements are typically made from foamed materials like EVA or PU (polyurethane).

Although foamed materials are generally well suited for use in midsoles, it has been found that they cause considerable problems in certain situations. A general shortcoming is the comparatively high weight of the dense foams, which is a particular disadvantage for use in running shoes.

A further disadvantage is the low temperature properties. Over the last years running or jogging has evolved into a sport which is performed during every season of the year. However, the elastic recovery of foamed materials decreases substantially at temperatures below freezing. This is exemplified in the hysteresis graph of Fig. 6c (dashed line), which reflects the compression behavior of a foamed deformation element at -25°C.

As can be seen, the element has lost its elastic recovery to a great extent and partly remains in its compressed state even after the external force has been completely removed (cf. the arrow in Fig. 6c). Although a temperature of -25°C may seem to be an extreme example, similar effects - as well as an accelerated wear of foamed elements - can already be observed at higher temperatures.

Finally, the possibilities of achieving certain deformation properties are very limited, if foamed materials are used:

Apart from the thickness of such an element, which is mostly determined by the dimensions of the sole and thus not variable, only the used starting substances can

be exchanged, if a softer or harder cushioning is desired. This is in particular a disadvantage in the case of the specifically designed shoe sole according to the DE 101 12 821, since there is only one parameter available for the adaptation of the deformation elements to their different functions in the shoe sole.

Accordingly, there have been approaches in the prior art for some time to replace foamed materials in the midsole by other elastically deformable structures. Examples can be found in the EP 0 558 541, the EP 0 694 264, the EP 0 741 529, the US 5,461,800 the US 5,822,886 and the US design patent No. 376,471 of applicant of the present invention.

A further sole construction of this type is disclosed in the US 4,611,412 and the US 4,753,021. In this construction the elasticity is provided by ribs running in parallel which are optionally interconnected by thin elastic bridging elements (cf. Figs. 10 and 11 of the mentioned documents). The bridging elements are thinner than the ribs themselves so that they can be directly elastically stretched when the ribs are deflected.

However, until now these constructions for the replacement of the foamed materials have not become generally accepted. The reason is that the suggested alternative structures and materials used for such deformation elements have up to now not been able to demonstrate the advantageous properties of foamed materials (at normal temperatures), i.e. the good cushioning and the comfort for the wearer resulting therefrom as well as the long lifetime.

The present invention is therefore based on the problem of providing a shoe sole which overcomes the disadvantages of shoe soles with foamed materials as well as the disadvantages of known shoe soles without the use of such materials.

## 3. Summary of the invention

The present invention relates to a shoe sole, in particular for a sports shoe, with a first area with a first deformation element and a second area with a second deformation element, wherein the first deformation element comprises a foamed material and wherein the second deformation element has a honeycomb-like structure and is free of foamed materials.

The shoe sole of the invention is based on the realization that the combination of deformation elements of foamed materials in first sole areas with deformation elements with honeycomb-like structures without foamed materials in second sole areas combines the advantages of the two construction principles for a shoe sole and eliminates their disadvantages.

The use of foamed materials in certain areas can e.g. lead to an optimally even deformation behavior when contacting the ground with the shoe sole of the invention, while the honeycomb-like second deformation element simultaneously ensures a minimum elasticity even at extremely low temperatures.

The second deformation element preferably comprises at least two side walls and at least one tension element interconnecting the two side walls. This results in deformation properties of the shoe sole of the invention which substantially correspond to the behavior of an ordinary midsole, made exclusively of foamed materials: With lower forces, small deformations of the side walls are dominant. With higher loads, the resulting tension force on the tension element is sufficiently large for an extension and thus for a larger deformation. Measurements have shown that over a wide range of loads this results in properties corresponding to the properties of a standard foamed midsole.

Besides the weight, which is reduced by 20 % to 30%, an important advantage is the fact that the deformation properties are almost independent from the ambient

temperature. The shoe sole of the invention still shows the necessary elasticity, even at temperatures of -25°C.

Preferably, at least the two side walls and the tension element are made in one piece from a thermoplastic material, preferably a thermoplastic polyurethane. The thermoplastic material has preferably a hardness between 70 and 85 Shore A, most preferably between 75 and 80 Shore A. The side walls and/or the tension element in-between have a preferred thickness ranging from 1.5 to 5 mm, wherein the thickness of the side walls and/or the tension element increases from the external edges to the middle of the second deformation element.

It is possible to set the deformation properties over a large range by means of these parameters, i.e. the material properties of the used plastic material and the exact wall thickness of the side walls and the tension element in order to optimize them for the tasks of the respective deformation element within the shoe sole and the overall use of the respective shoe sole.

Further, the at least two side walls are preferably interconnected by an upper and/or a lower side.

In another preferred embodiment, two second deformation elements are arranged side by side, wherein an upper and/or a lower side interconnects adjacent side walls of two deformation elements. The second deformation elements, arranged side by side, are preferably interconnected by an additional upper and/or lower connecting surface. The connecting surface has preferably a three-dimensional shape for adaptation to further sole parts. This not only facilitates the anchoring of the deformation elements in the sole ensemble during production, but also helps to increase the lifetime of the shoe sole.

The tension element preferably interconnects middle ranges of the at least two side walls, wherein the side walls each have preferably a bent configuration.

Changes in the structure of the deformation element by such additional upper and/or lower sides etc. are another possibility for adapting the deformation properties of the deformation element.

A first area is preferably provided in the rear heel part of the shoe sole and a second area is preferably provided in the front heel part of the shoe sole. This results in optimal cushioning when the foot contacts the ground and simultaneously avoids a premature wear of the cushioning elements in the heel range. The rear heel part is the part of the shoe sole subjected to the highest loads during a step cycle. Cushioning these loads by deformation elements of foamed material is the precondition for a particularly high comfort for the wearer of the shoe.

Preferably, a first area is provided below the front ends of the metatarsals of the foot of the wearer of the shoe. The foot pushes off the ground via this area of the shoe sole. Tests have shown that the human foot is particularly sensitive in this area of the sole. Deformation elements of foamed material avoid pressure points on the foot sole in this area. Second areas are preferably provided in front of and/or behind the front end of the metatarsals of the foot of the wearer of the shoe and thus protect the first foamed deformation element against excessive loads. Simultaneously, they allow for a more purposeful control of the series of movements in order to avoid supination or excessive pronation when pushing off the ground and maintain the foot's neutral position.

Preferably, the first and second deformation elements are provided below at least one load distribution plate of the shoe sole wherein the at least one load distribution plate preferably three-dimensionally encompasses the first and/or second deformation element. The load distribution plate provides for an evenly distributed pressure load on the foot sole and thus increases comfort for the wearer of the shoe. Preferably, the load distribution plate encompasses the first and/or second deformation element(s) three-dimensionally and thus improves the stability of the entire shoe sole.

In a presently preferred embodiment, the first deformation element comprises a shell forming a cavity at least partly filled with a foamed material. Thus, the superior cushioning properties of a foamed material are combined with a wide range of adjustment options provided by varying the shape and the wall thickness of the shell. For example, a gradually changing hardness of the first deformation element can be achieved by gradually varying the wall thickness of the shell without having to provide a foamed material with a varying density. This reduces the cost for producing the first deformation element.

A further advantage is that the combination of a shell encapsulating one or more foamed materials allows to achieve the desired cushioning properties with a deformation element of reduced size. Accordingly, the limited space available on the shoe sole, in particular in the rearfoot part, can be more effectively used for arranging further functional elements on the shoe sole.

Preferably, the shell comprises a thermoplastic material, preferably a thermoplastic urethane (TPU). A shell made from this material is not only more durable than a standard foam element. In addition, the elastic properties of the TPU are less temperature dependent and thereby lead to more consistent cushioning properties of the shoe under changing conditions. The foamed material is preferably a PU foam.

In a particularly advantageous embodiment, the first deformation element is arranged at the rearmost part of the shoe sole and its cavity comprises preferably a lateral and a medial chamber. As a result, the cushioning properties of the lateral side, where the first ground contact will typically occur and the medial side can be separately designed. Preferably, the lateral chamber is larger than the medial chamber to provide sufficient cushioning for the heel strike.

Additional advantageous modifications of the shoe sole according to the invention form the subject matter of further dependent claims.

## 4. Short description of the drawing

In the following detailed description presently preferred embodiments of the invention are described with reference to the drawing which shows:

| | |
|---|---|
| Fig. 1: | A side view of two second interconnected deformation elements for use in an embodiment of the invention; |
| Fig. 2: | The perspective top view of the two deformation elements of Fig. 1; |
| Fig. 3: | A further embodiment of two second interconnected deformation elements in their unloaded configuration; |
| Fig. 4: | The deformation elements of Figure 3 in the compressed state; |
| Fig. 5: | An alternative embodiment of a series of second deformation element(s); |
| Figs. 6a to 6c: | Comparative measurements of the deformation properties (at different temperatures) of second deformation elements of the present invention and of a prior art deformation element made out of a foamed material; |
| Fig. 7: | Side view of a shoe with an embodiment of a shoe sole according to the present invention; |
| Fig. 8: | Exploded representation of the construction of the shoe sole of Fig. 7; |

Fig. 9: Exemplary arrangement of first and second deformation elements in a sole of Figures 7 and 8;

Fig. 10: Side view of a shoe with a further embodiment of a shoe sole according to the present invention;

Fig. 11: Side view of a shoe sole according to another embodiment of the present invention;

Fig. 12: Perspective lateral view slantwise from below of the embodiment of Fig. 11;

Fig. 13: Perspective front view of a first deformation element according to a presently preferred embodiment;

Fig. 14: Perspective rear view of the shell of the first deformation element of Fig. 13 without the foamed material; and

Fig. 15a, b: Lateral and medial side view, respectively, of the rearmost section of a shoe sole comprising a first deformation element as shown in Figs. 13, 14.

## 5. Detailed description of preferred embodiments

In the following, preferred embodiments of the shoe sole according to the invention are discussed. The shoe sole can be used in all types of shoes. However, the most important field of use is sports shoes, since the realization of good cushioning and support properties for the foot at a reduced weight is of particular importance for these types of shoes.

Figure 1 shows a side view of a pair of deformation elements 1 for a shoe sole of the invention. Each deformation element 1 has approximately a honeycomb-like shape including two facing, preferably slightly angled side walls 2a, 2b, which are interconnected via a tension element 3. The term "honeycomb-like" is to comprise every structure, wherein hollow volumes within the shoe sole are defined by means of flat elements such as the side walls 2a, 2b and the tension element 3.

The tension element 3 is provided as a surface extending approximately from the centre of the side wall 2a approximately to the center of the side wall 2b. The wall thickness of the side walls 2a, 2b and of the tension element 3 can vary in order to design mechanical properties with local differences. In a preferred embodiment (not shown), the wall thicknesses in the deformation element 1 increase from the outside to the middle. This facilitates removal from the mould in the case of injection-moulding production. Preferred wall thicknesses are in the range of 1.5 to 5 mm.

In the embodiment of Fig. 1 the side walls 2a, 2b of the deformation element 1 are further interconnected by an upper side 4 and a lower side 5. The areas 4 and 5 serve as supporting surfaces, which may be engaged by forces within the shoe sole, which are to be absorbed by the deformation element 1. Additionally, two or more of the described deformation elements 1 can be interconnected to each other at their upper and/or their lower end by a further connecting surface 10. Such a connecting surface 10 provides a mutual stabilization of two or more deformation elements 1. Additionally, it facilitates their anchoring inside the shoe sole, since it provides a greater contact surface for the attachment to other sole elements, for example by gluing, welding, etc..

The connecting surface 10 may be three-dimensionally shaped in order to allow a more stable attachment to other sole elements, for example the load distribution plate 52 described below. In Fig. 2, this is schematically indicated by the recess 11.

The Figs. 3 and 4 show a further embodiment of two pair-wise interconnected deformation elements 1 including an upper and lower connecting surface 10. The two interconnected deformation elements 1 of Figs. 3 and 4 have a different size similar to the embodiment shown in Figs. 1 and 2. This reflects the conditions for the preferred adjacent arrangement within the shoe sole 50 (cf. Figs. 7, 8, 10, 11, and 12). The deformation elements 1 are arranged in a region of the shoe sole 50 with varying thickness. Accordingly, they have to have different sizes.

Whereas Fig. 3 shows the unloaded state of the two deformation elements 1, Fig. 4 schematically presents the specific deformation behavior. In case of a small load there is at first only a small deflection of the side walls 2a, 2b without a substantial influence of the tension element 3. This first level of deflection, however, is stopped in case of an increasing force by the tension element 3, since any further deformation of the side walls 2a, 2b requires an elongation of the tension element 3. Larger pressure forces F acting from above (and / or from below) are therefore transformed by the deformation element 1 according to the invention into a tension inside the tension element 3 (cf. dashed double headed arrows in Fig. 4). The tension element 3 allows that even in case of a peak load the deformation element 1 is not simply flattened but elastically deformed over a wide range of loads, similar to a deformation element made from foamed materials.

Fig. 5 shows another embodiment of several second interconnected deformation elements 1 for use in a shoe sole of the present invention. Unlike the embodiments of Figs. 1 - 4, the side walls 2a, 2b of the same deformation element 1 are not interconnected by means of upper and lower sides, but the structure has been modified in that an upper side 4' and a lower side 5' each interconnect side walls 2a, 2b of adjacent deformation elements 1. In this alternative, the additional use of a connecting surface 10 (not shown) is also possible, interconnecting additionally a number of deformation elements 1 on their upper and/or lower sides. The embodiment of the honeycomb-like deformation element 1 shown in Fig. 5 is in par-

ticular appropriate for use in sole areas with a low height, e.g. at the front end of shoe sole 50.

The strong similarity of the deformation characteristics of the described deformation element 1 and a prior art deformation element made from foamed materials is shown in Figs. 6a and 6b. At a surrounding temperature of 23°C or 60°C, respectively, hysteresis curves for the deflection of deformation elements according to the invention of two different thermoplastic polyurethanes (TPU) with a Shore A hardness of 80 and 75, respectively, were compared with a prior art deformation element made from polyurethane with an Asker C hardness of 63. This is a typical value for deformation elements used in midsoles of sports shoes.

For such a measurement the deformation element is by means of an oscillating stamp subjected to a force which increases at first (in the graphs to approximately 1000 N, Y-axis) and subsequently decreases. The deflection of the deformation element is simultaneously measured (X-axis). The gradient of the obtained curve indicates the stiffness of the deformation element, whereas the area between the increasing branch (loading) and the decreasing branch (unloading) of the curve reflects the "loss" of energy during deformation, i.e. energy which is not elastically regained but irreversibly transformed into heat by means of relaxation processes, etc..

The Figs. 6a and 6b show at room temperature (23°C) and at 60°C to a great extent consistency in the behavior of the deformation elements described above and the prior art foamed element. Also long term studies did not show a substantial difference in the deformation properties.

However, at low temperatures (-25°C) the situation, as shown in Fig. 6c, is different: Whereas the deformation elements made out of TPU still show a substantially elastic behavior and in particular return to their starting configuration after the external force has decreased to zero, the foamed deformation element remains

permanently deformed (cf. the arrow in Fig. 6c at a deflection of approximately 2,3 mm). As a result, a deformation element having such a deformation behavior is no longer suitable for use in a shoe sole.

In contrast to the known deformation elements, the described deformation elements 1 without foamed materials can be modified in many aspects to obtain specific properties: Changes of the geometric relations of the honeycomb-like deformation element (larger or smaller distances between the side walls 2a, 2b and/or the upper and lower sides 4, 4', 5, 5', respectively, changes of the angle in the side walls, convex or concave borders for reinforcing or reducing the stiffness etc.) or the use of different materials enables to a great extent the adaptation of the deformation properties to the respective use. Thus, the particular position of the deformation element 1 within the shoe sole 50 can be taken into account as well as requirements for the shoe in general, as for example its expected field of use or the size and the weight of the wearer.

The manufacture of the described deformation elements 1 is cost efficient, since the described honeycomb-like shape allows a manufacture in one piece by means of known plastic processing techniques like injection molding, etc..

Starting from the above discussed good deformation properties of the described deformation elements (even at low temperatures), it is obvious to completely replace the foamed materials used until now for the midsole region. However, applicant has found that the use of deformation elements of the described structure is in certain sole regions uncomfortable for athletes and creates pressure points on the foot sole.

Fig. 7 shows a side view of a shoe with a first embodiment of a shoe sole 50 according to the invention, which takes this knowledge into account. Fig. 8 shows the construction in an exploded view: A plurality of separate deformation elements 1, 20 are arranged between an outsole 51 and a load distribution plate 52.

Deformation elements 20 made out of foamed materials are arranged in particularly sensitive areas of the sole, whereas honeycomb-like deformation elements 1, having preferably the structure explained in detail above, are arranged in other areas.

In the preferred embodiment of Fig. 7, one or more deformation elements 20 made out of foamed material are arranged at the rear end of the heel part of the sole in order to optimally cushion the peak loads on the foot arising during the first ground contact. In contrast thereto, honeycomb-like deformation elements 1 are preferably provided in the front section of the heel part to assist the rear end deformation element 20 and to assure in case of its failure, for example due to low temperatures, a minimum of elasticity of the shoe sole 50.

The distribution of the deformation elements 1, 20 on the medial and lateral sides of the sole as well as their individual specific deformation properties can be tuned to the desired requirements, for example avoiding a supination or an excessive pronation, etc.. In particular this can be done by using the above mentioned possibilities for an individual adaptation of the deformation properties of each individual honeycomb-like deformation element 1 by a suitable geometrical structure and / or an appropriate material selection.

Fig. 9 schematically shows a top view of an exemplary distribution of the deformation elements 1, 20. As a general rule, due to their better adjustability the honeycomb-like deformation elements 1 allow an improved control over the course of motion during a step cycle, whereas shoes with a focus on a particularly good cushioning will rather use foamed deformation elements 20.

In the forefoot region foamed deformation elements are preferably arranged in areas of the sole 50, which are positioned below the heads of the metatarsals of the foot. This region of the sole 50 is subjected to a particular load during push-off at the end of the step cycle. Accordingly, it is preferred in this embodiment not to

arrange honeycomb-like deformation elements 1 in this sole region in order to avoid localized pressure points on the foot sole. Furthermore, the foamed deformation elements 20 may comprise horizontally extending indentations/grooves 21, to obtain a particular ease of deformation. Honeycomb-like deformation elements 1 are provided further to the front and further behind in the forefoot region of the sole 50, in order to assist the deformation element 20 below the heads of the metatarsals and to assure a correct position of the foot during the pushing-off phase by means of the more precise possibilities for a fine tuning of the deformation properties.

The provision of a load distribution plate 52 arranged above the deformation elements 1, 20 distributes the forces acting on the foot over the full area of the foot sole and thereby avoids localized peak loads on the foot. If necessary, the mid foot region can be reinforced by a light, but highly stable carbon fiber plate 53 (cf. Fig. 8), which is inserted into a corresponding recess 54 of the load distribution plate 52.

The torsional and bending behavior of the complete sole 50 is preferably influenced by the form and length of a gap 55 in the outsole 51, as well as by the stiffness of the curved interconnecting ridges 56 between the heel part and the forefoot part of the sole, which reinforce corresponding curvatures 57 of the outsole 51. However, it is also conceivable to integrate a specific torsion element into the sole 50 (not shown) which interconnects in a defined manner the heel part and the forefoot part of the sole.

The ridges 58, which are only schematically indicated in Fig. 8, serve for a secure anchoring of the deformation elements 1, 20 in the sole ensemble and may in a similar manner be arranged in the heel part. On its upper side the sole construction illustrated in Fig. 8 is terminated by an additional midsole 60.

Fig 10. shows an alternative embodiment wherein the honeycomb-like deformation elements 1 are exclusively arranged in the front part of the heel region. In this embodiment the forefoot region and the heel region have separate load distribution plates 52 with the deformation elements 1, 20 being arranged there below. Both load distribution plates 52 are bent in a U-shaped manner, if regarded from the side, and encompass at least partly one or more deformation elements 1, 20. This further increases the stability of the sole ensemble. Particularly wear resistant reinforcements 59 of the outsole 51 may be arranged at the front or rear end of the sole 50.

Providing a load distribution plate, bent in a U-shaped manner, is independent of the use of honeycomb-like deformation elements 1. It is also possible to provide honeycomb-like deformation elements 1 only in the forefoot region and to provide nevertheless the two load distribution plates 52 of Fig. 10. It is also possible to combine two load distribution plates 52 as in Fig. 10 with honeycomb-like deformation elements in the heel area and in the forefoot area.

In another embodiment, shown in Figs. 11 and 12, honeycomb-like deformation elements 1 are provided on the lateral as well as on the medial side of the shoe sole 50, contrary to Fig. 9. A provision only on the lateral side or a configuration extending from the lateral to the medial side is also possible.

The load distribution plate 52 extends along almost the entire length of the shoe sole 50, i.e. from the heel area to the forefoot area. Also in this embodiment, deformation elements 20 of foamed materials are provided in the particularly sensitive areas of the shoe sole 50, i.e. the rear heel part and approximately below the front ends of the metatarsals, whereas the other sole areas are supported by honeycomb-like deformation materials 1 without foamed materials.

Figs. 13 - 15 show a particularly preferred embodiment of a first deformation element 70 comprising foamed material. However, in contrast to the deformation

element 20 discussed above, which consists exclusively of foamed material, the deformation element 70 is a hybrid structure including an outer shell 71 forming one or more cavities filled with the foamed material 72. The outer shell 71 has two effects: At first, it provides some cushioning in a manner similar to the honeycomb-like second deformation element 1 due to its own elastic deflection under load. In addition, it contains the foamed material 72 arranged therein and hinders its excessive expansion to the side in case of peak loads. As a result, a premature fatigue of the foamed material 72 is avoided. Finally, the cushioning properties of the shell 71 alone are less temperature dependent than the foamed material alone, similar to the honeycomb-like deformation element 1.

Fig. 13 - 15b illustrate a first deformation element 70 as it is used in the rearmost section of the heel part. However, a first deformation element 70 comprising an outer shell 70 and a foam filling 72 can also be used for other parts of the shoe sole 50 in a similar manner to the above described deformation elements 20.

As shown in the perspective front view of Fig. 13 and in the presentation of the outer shell 71 in Fig. 14, the deformation element 70 comprises a lateral chamber 73 and a medial chamber 74. The lateral chamber 73 is larger and designed to cushion the high ground reaction forces during the first ground contact with the heel, which occurs with the majority of the athletes on the lateral rear side of the shoe sole. However, if desired, it is also possible to provide a greater chamber on the medial side.

The lateral and the medial chambers 73, 74 are interconnected by a bridging passage 75, which is also filled with foamed material in the presently preferred embodiment. Due to the improved cushioning properties of the hybrid structure, it is not necessary to cover the entire rearfoot part with the deformation element 70 and an open recess 76 can be arranged below the bridging passage 75. The recess 76 can be used to receive further functional elements of the shoe sole (not shown)

and allows in addition a more independent deflection of the lateral chamber 73 and the medial chamber 74 of the deformation element 70.

Both, the outer shell 71 and the foam filling 72 determine the elastic properties of the deformation element 70. Accordingly, the described hybrid structure provides several possibilities to modify its elastic properties. Gradually changing the wall thickness of the shell 71, for example from the medial to the lateral side, will lead to gradually changing hardness values of the deformation element 70. In addition, reinforcing structures inside the lateral or the medial chamber, similar to the tension element 3 of the honeycomb-like deformation element 1, allow to selectively strengthen specific sections of the deformation element 70. A further option is to use foamed materials of different densities in the lateral chamber 73 and the medial chamber 74 of the deformation element (or in other cavities, not shown in the embodiment of Figs. 13 and 14).

Figs. 15a and 15 b finally show the preferred arrangement of the deformation element 70 in the rearmost section of the heel part of the shoe sole (only partly shown). As in the case of the deformation element 20 discussed above, a second deformation element 1 is arranged next to the first deformation element 70 providing additional support immediately after the cushioning of the heel strike. The embodiment shown in Figs. 15a and 15b further discloses an upwardly directed projection 80 of the deformation element 70 arranged on top of the bridging passage 75. This projection 80 facilitates a reliable bonding to the rest of the shoe sole and to the upper of the shoe.

The shell 71 is preferably made from a thermoplastic material such as a thermoplastic urethane (TPU) having preferably an Asker C hardness of 65. As mentioned above with respect to the honeycomb-like deformation element 1, TPU can easily be three-dimensionally formed at low costs, for example by injection molding. The foamed material is preferably a PU-foam, (polyurethane foam), which is either pre-fabricated and subsequently inserted into the shell 71 or cured

inside the cavity of the shell. Particularly preferred is a 58 PU foam (45% rebound).

March 28, 2003

adidas International Marketing B.V. ADI37832EP HS/Wg/aj/tge

## Claims

1. Shoe sole (50) in particular for a sports shoe comprising:

   a. a first area with a first deformation element (20, 70);

   b. a second area with a second deformation element (1); wherein

   c. the first deformation element (20, 70) comprises a foamed material; and

   d. the second deformation element (1) comprises a honeycomb-like structure and is free from foamed materials.

2. Shoe sole (50) according to claim 1, wherein the second deformation element comprises at least two side walls (2a, 2b), and at least one tension element (3) interconnecting the two side walls (2a, 2b).

3. Shoe sole (50) according to claim 2, wherein the at least two side walls (2a, 2b) and the tension element (3) are made in one piece from a thermoplastic material.

4. Shoe sole (50) according to claim 3, wherein the thermoplastic material is a thermoplastic polyurethane.

5. Shoe sole (50) according to any of the claims 3 or 4, wherein the thermoplastic material has a hardness between 70 and 85 Shore A, preferably between 75 and 80 Shore A.

6. Shoe sole (50) according to any of the claims 2 - 5, wherein the side walls and/or the tension element have a thickness in the range of 1,5 to 5 mm.

7. Shoe sole (50) according to any of the claims 2 - 6, wherein the thickness of the side walls (2a, 2b) and / or the tension element (3) increases from the outer edges to the center of the second deformation element (1).

8. Shoe sole (50) according to any of the claims 2 - 7, wherein the at least two side walls (2a, 2b) are further interconnected by an upper side (4) and/or a lower side (5).

9. Shoe sole (50) according to any of the claims 2 - 8, wherein two second deformation elements (1) are arranged adjacent to each other.

10. Shoe sole (50) according to claim 9, wherein an upper side (4') and / or a lower side (5') interconnect adjacent side walls (2a, 2b) of two deformation elements (1) arranged adjacent to each other.

11. Shoe sole (50) according to any of the claims 9 or 10, wherein the adjacently arranged second deformation elements arranged adjacent to each other are interconnected by an additional upper and/or lower connecting surface (10).

12. Shoe sole (50) according to claim 11, wherein the connecting surface (10) has a three-dimensional shape (11) for adaptation to further sole components.

13. Shoe sole (50) according to any of the claims 2 - 12, wherein the tension element (3) interconnects center regions of the at least two side walls (2a, 2b).

14. Shoe sole (50) according to any of the claims 2 - 13, wherein the side walls (2a, 2b) each have an angled configuration.

15. Shoe sole (50) according to any of the claims 1 to 14, wherein the first area is arranged at the rear end of the heel region of the shoe sole (50).

16. Shoe sole (50) according to claim 15, wherein a second area is provided at the front part of the heel region of the shoe sole (50).

17. Shoe sole (50) according to any of the claims 1 to 16, wherein a first area is arranged below the heads of the metatarsals of the foot of the wearer of the shoe.

18. Shoe sole (50) according to claim 17, wherein second areas are arranged in front and/or behind the heads of the metatarsal of the foot of the wearer of the shoe.

19. Shoe sole (50) according to any of the claims 1 - 18, wherein the first deformation element(s) (20, 70) comprise(s) horizontally extending indentations (21).

20. Shoe sole (50) according to any of the claims 1 - 19, wherein the first (20) and the second (1) deformation element are arranged below at least one load distribution plate (52) of the shoe sole (50).

21. Shoe sole (50) according to claim 20, wherein the at least one load distribution plate (52) three-dimensionally encompasses the first (20) and/or the second (1) deformation element.

22. Shoe sole (50) according to any of the claims 1 - 21, wherein the first deformation element(s) (70) comprise(s) a shell (71) forming a cavity at least partly filled with a foamed material (72).

23. Shoe sole (50) according to claim 22, wherein the shell (71) comprises a thermoplastic material, preferably a thermoplastic urethane and wherein the foamed material (72) is a PU foam.

24. Shoe sole (50) according to claim 22 or 23, wherein the shell (71) has a varying wall thickness.

25. Shoe sole (50) according to any of the claims 22 - 24, wherein the first deformation element (70) is arranged at the rearmost part of the shoe sole and wherein the cavity comprises a lateral chamber (73) and a medial chamber (74).

26. Shoe sole (50) according to claim 25, wherein the lateral chamber (73) is larger than the medial chamber (74).

27. Shoe sole (50) according to claim 25 or 26, wherein the lateral chamber (73) and the medial chamber (74) are interconnected by a bridging passage (75).

28. Shoe sole (50) according to claim 27, wherein the bridging passage (75) is filled with foamed material (72).

29. Shoe sole (50) according to any of the claims 25 - 28, wherein a recess (76) open to the outside is arranged between the lateral chamber (73) and the medial chamber (74).

30. Shoe comprising a shoe sole (50) according to any of the claims 1 - 29.

EPO - Munich
55



28. März 2003

March 28, 2003

adidas International Marketing B.V. ADI37832EP HS/Wg/aj/tge


**Summary**

The present invention relates to a shoe sole, in particular for a sports shoe, comprising a first area with a first deformation element and a second area with a second deformation element, wherein the first deformation element comprises foamed material and wherein the second deformation element has a honeycomb-like structure and is free from foamed materials.

Fig. 1

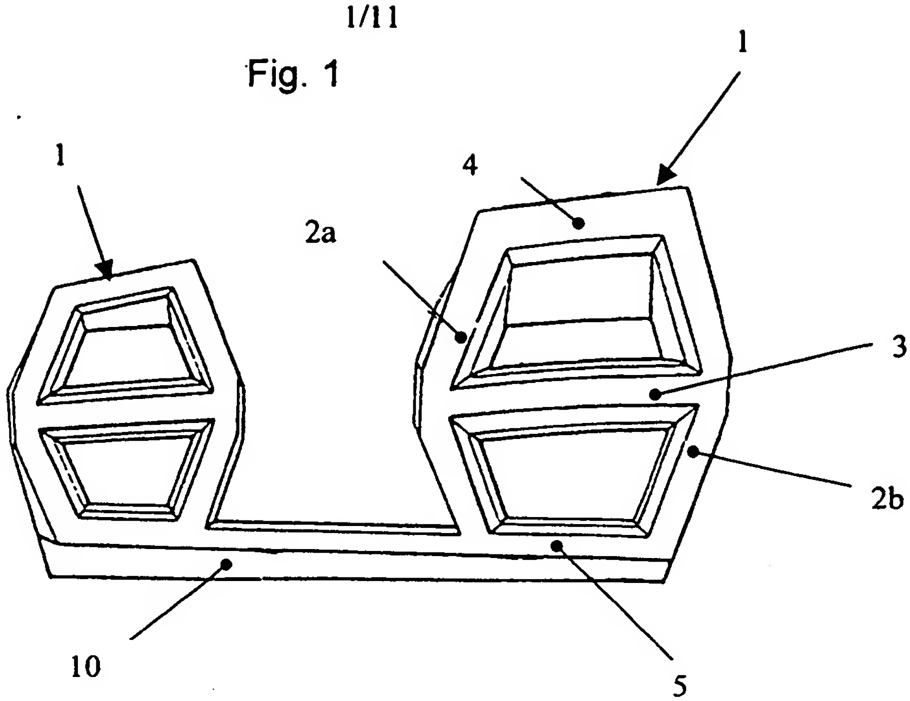



Fig. 2

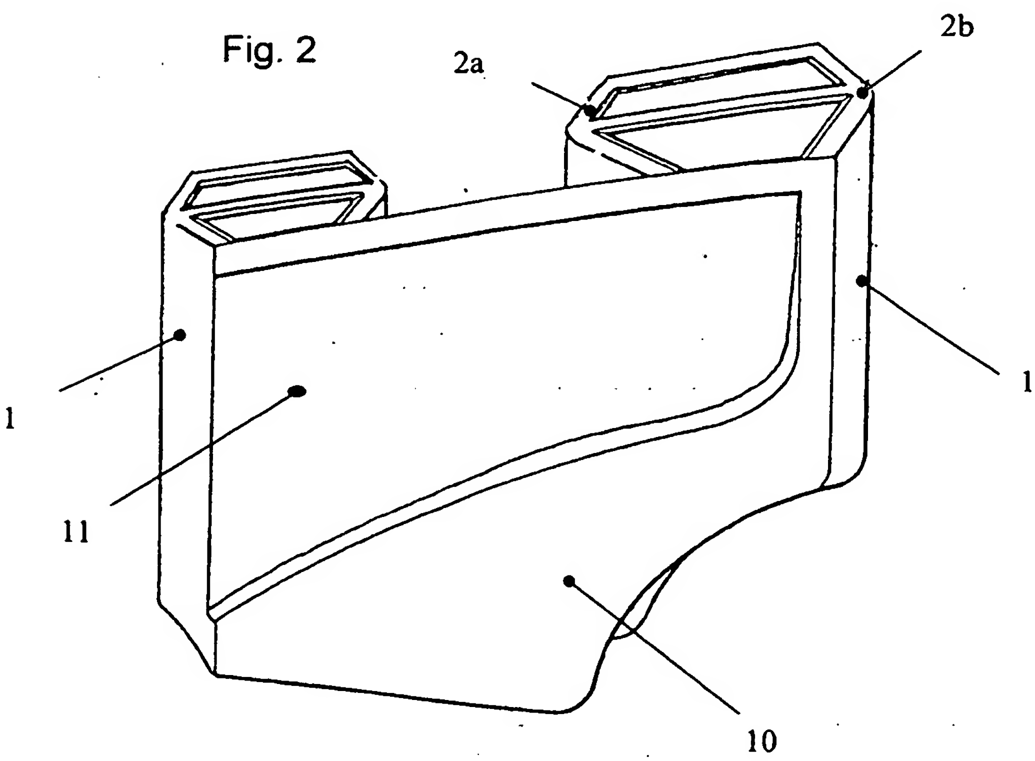


Fig. 3

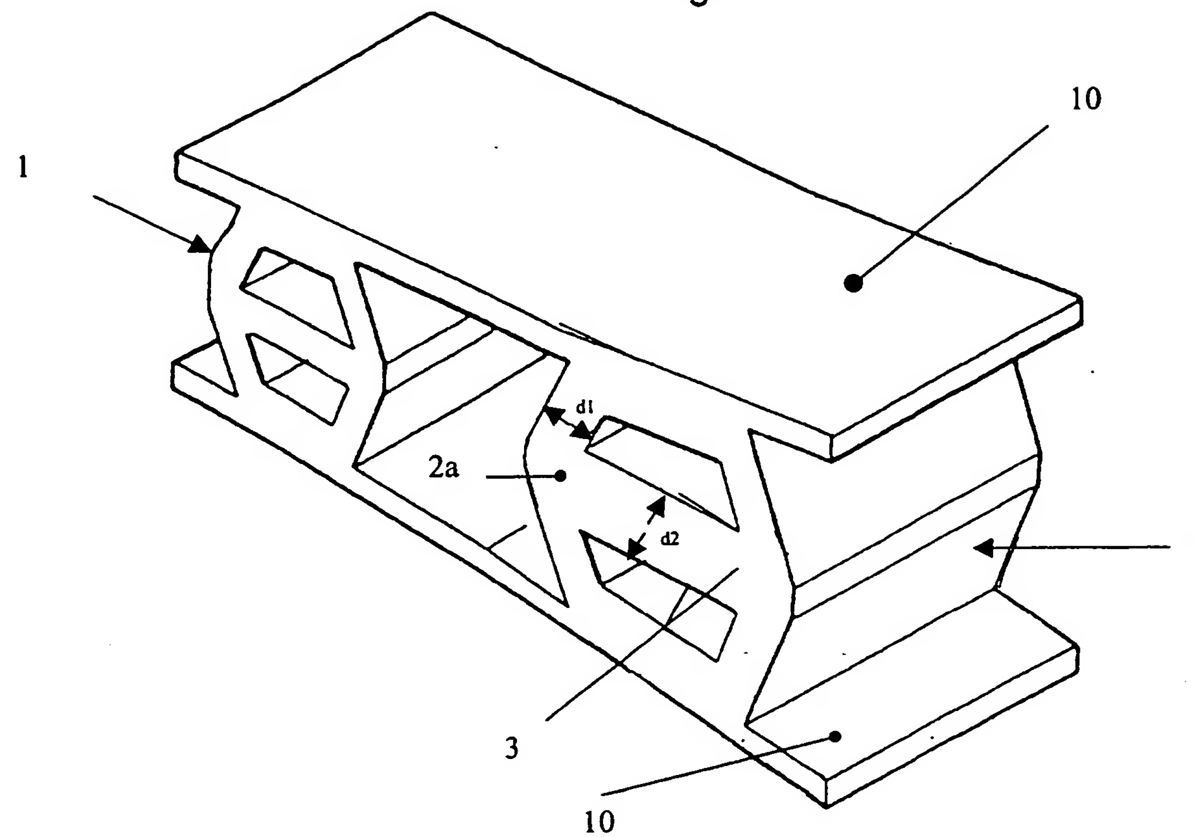



Fig. 4

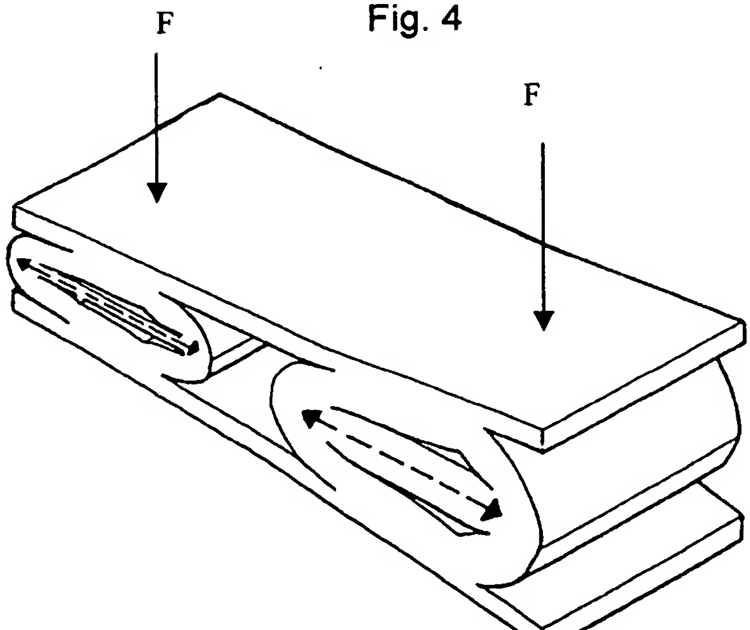
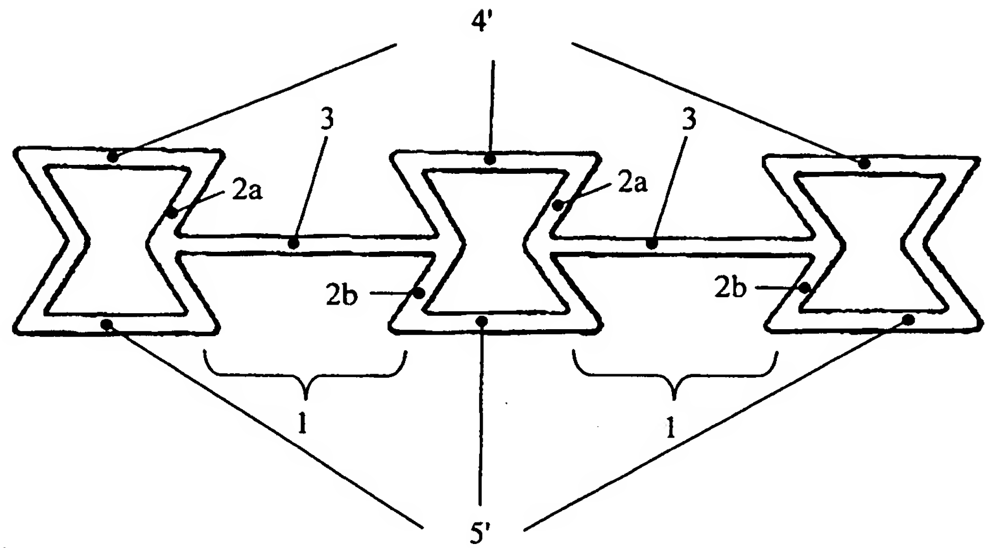


Fig. 5



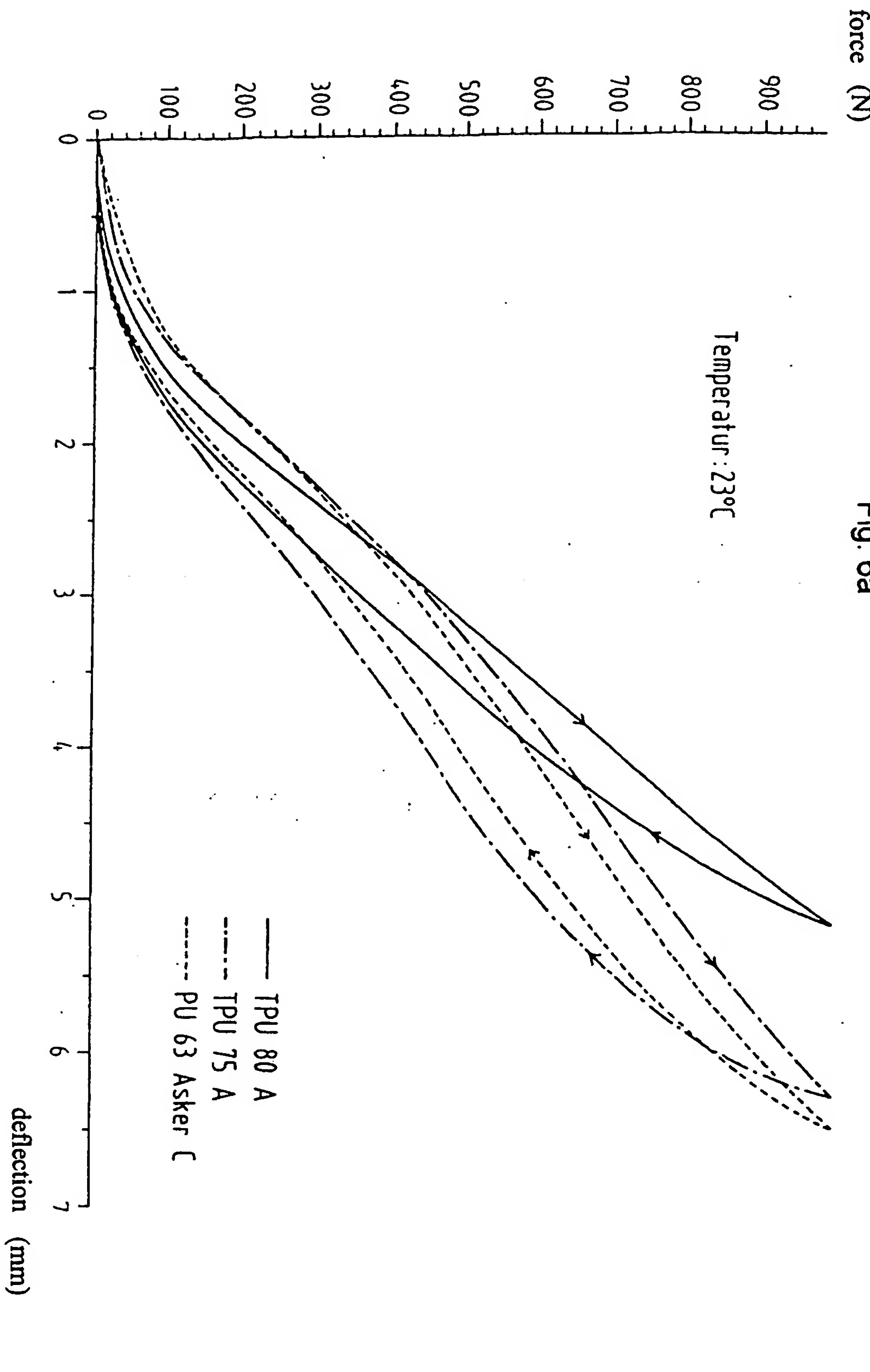

force (N)
0
100
200
300
400
500
600
700
800
900
0
1
2
3
4
5
6
7
deflection (mm)
Temperatur: 23°C
TPU 80 A
TPU 75 A
PU 63 Asker C

Fig. 6a

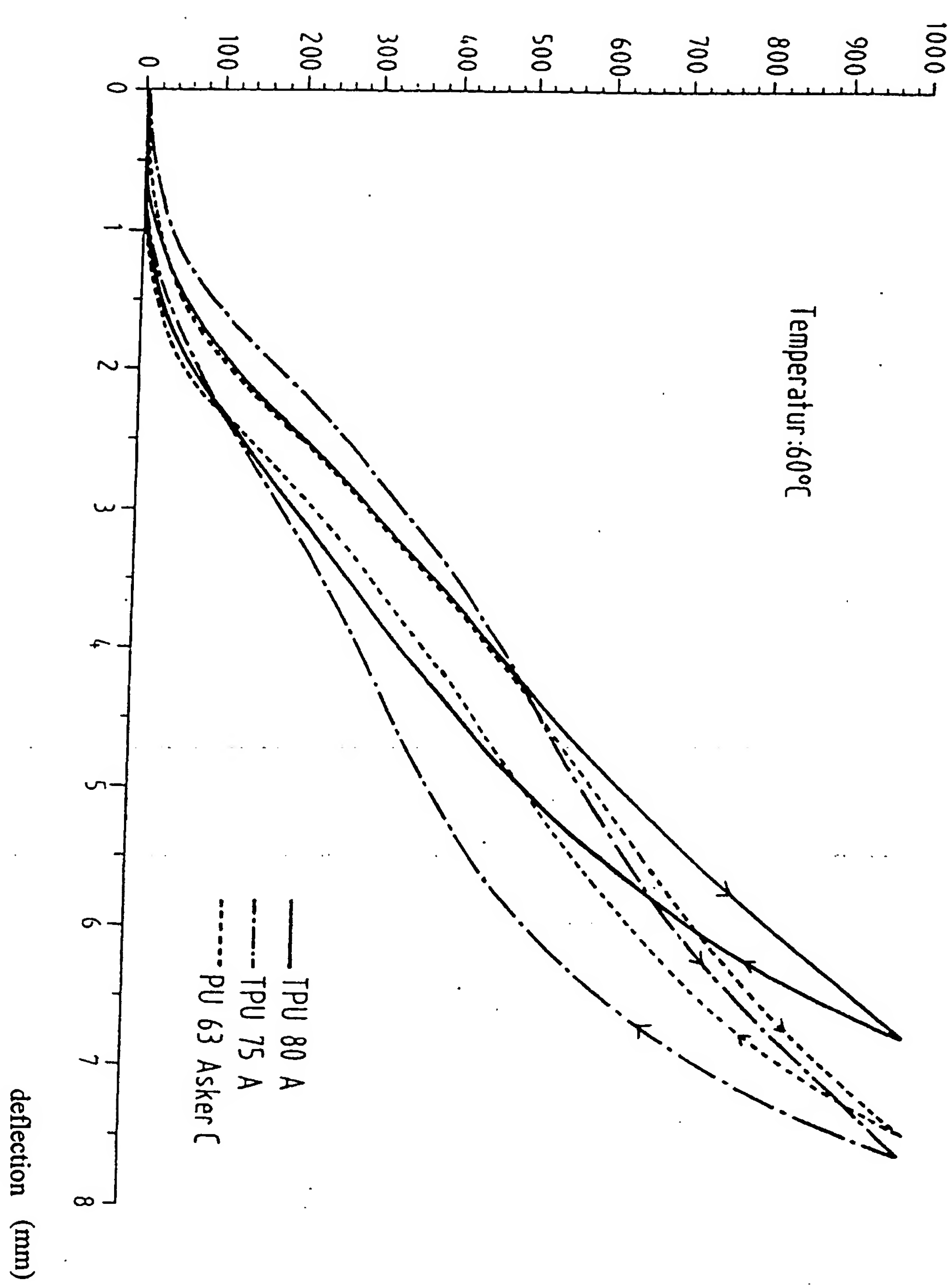

force (N)
0
100
200
300
400
500
600
700
800
900
1000
Temperatur :60°C
TPU 80 A
TPU 75 A
PU 63 Asker C
0
1
2
3
4
5
6
7
8
deflection (mm)

Fig. 6b

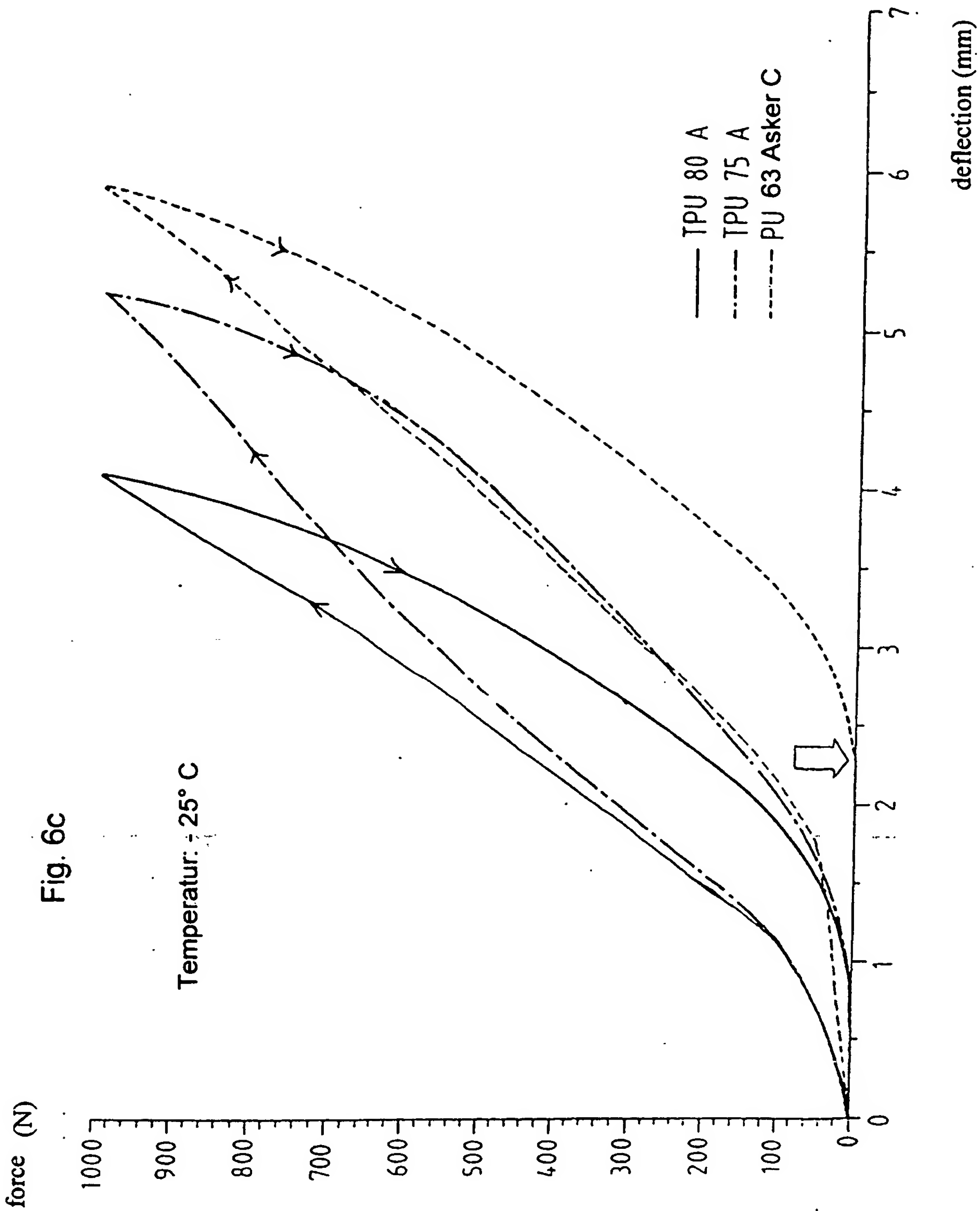
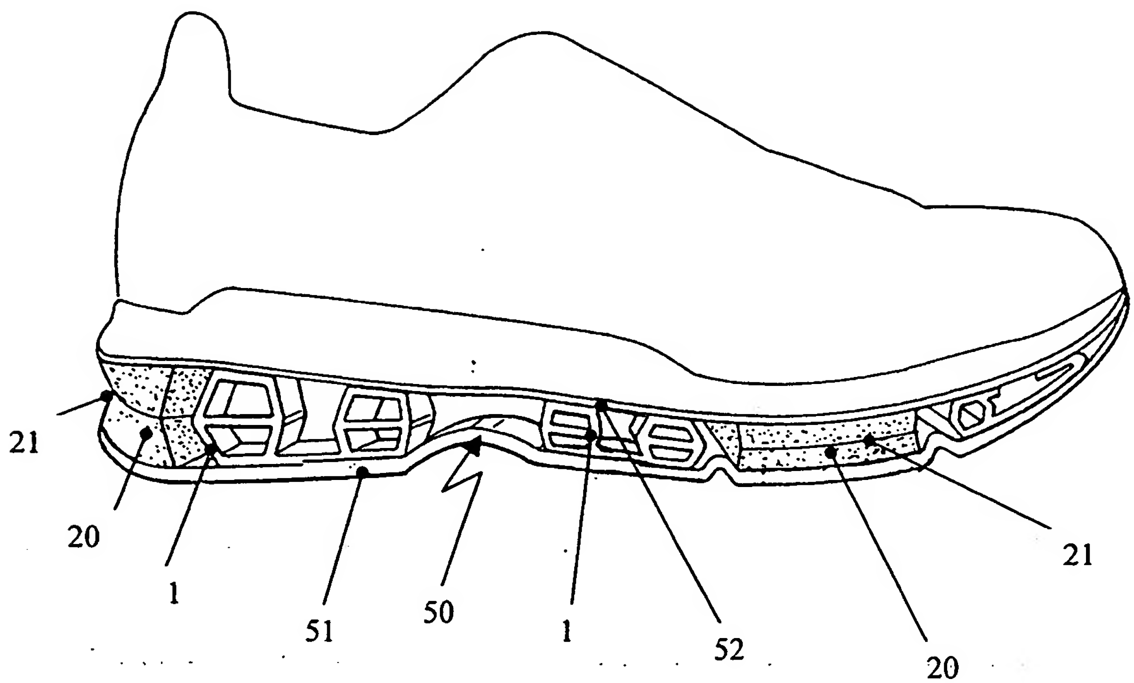

Temperatur: -25° C
TPU 80 A
TPU 75 A
PU 63 Asker C
force (N)
1000
900
800
700
600
500
400
300
200
100
0
0
1
2
3
4
5
6
7
deflection (mm)

Fig. 6c

Fig. 7



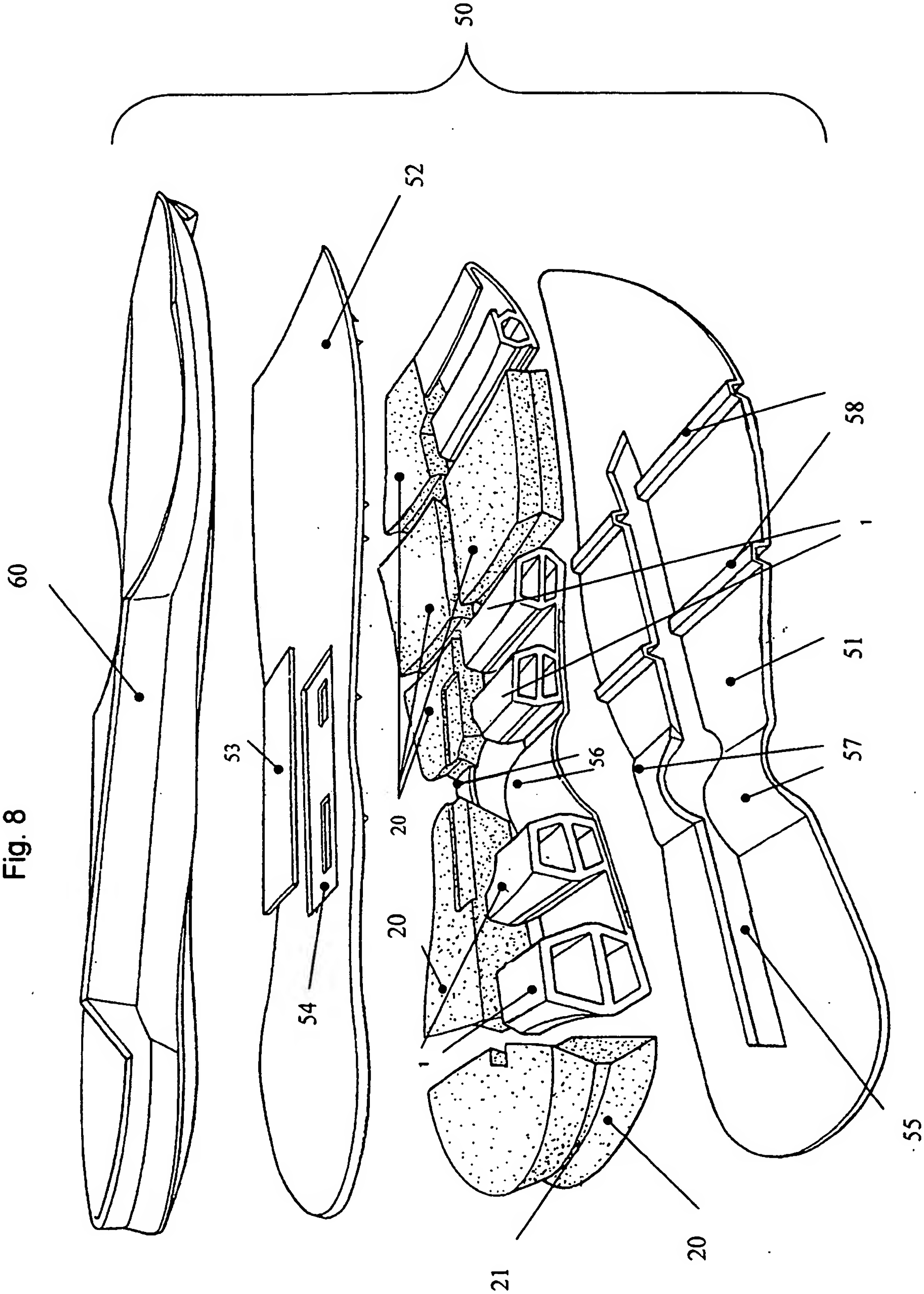



Fig. 8

Fig. 9

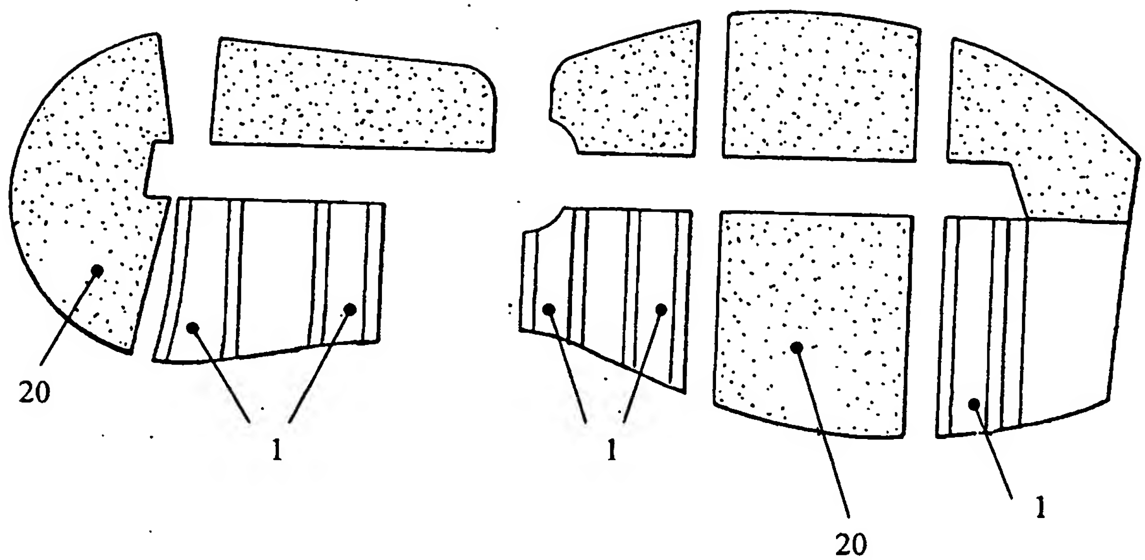



Fig. 10

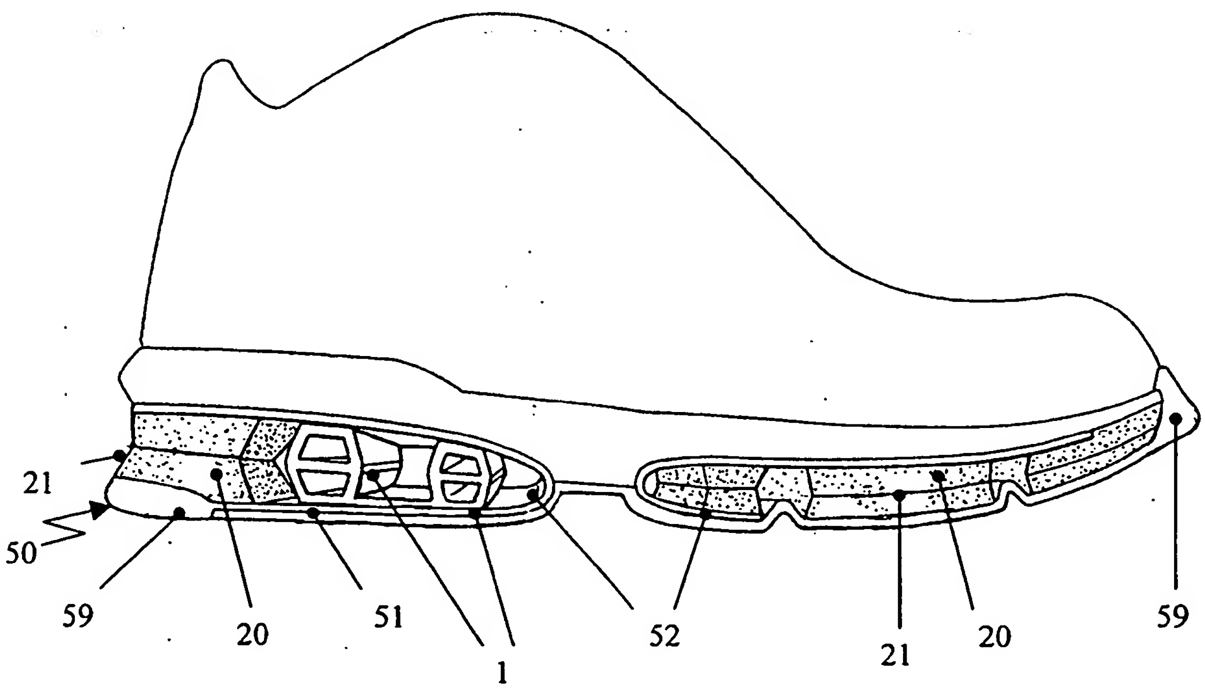


Fig. 11

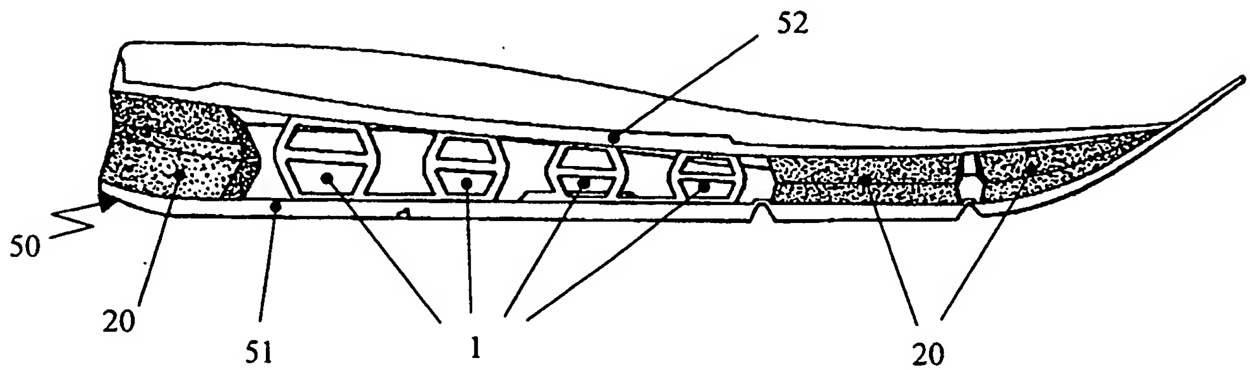



Fig. 12

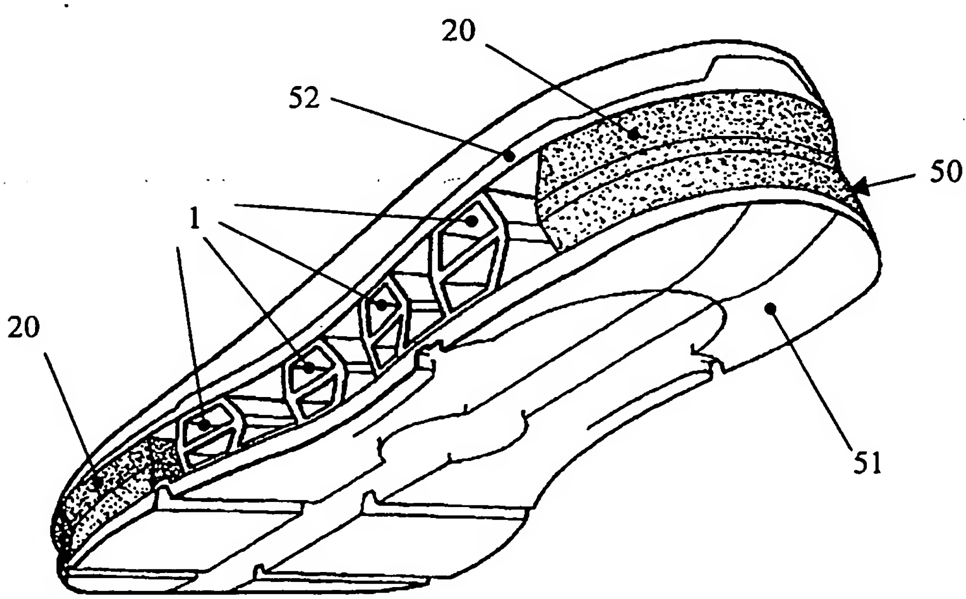


Fig. 13

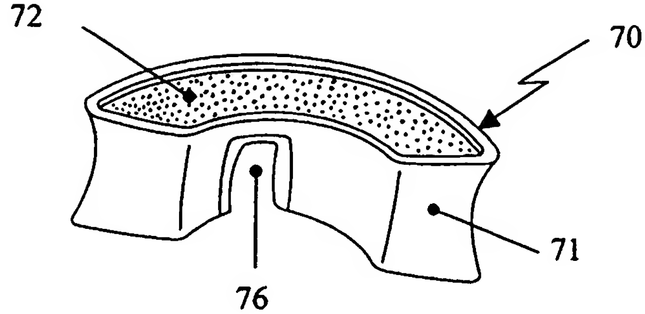



Fig. 14

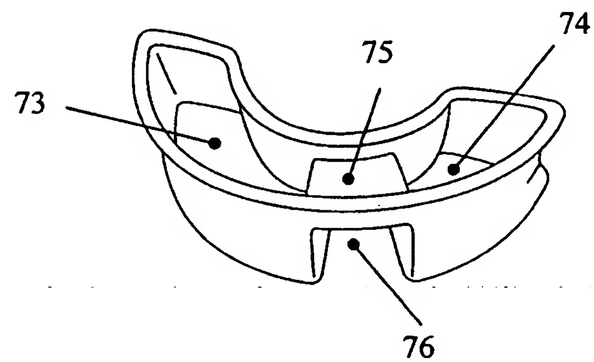



Fig. 15a

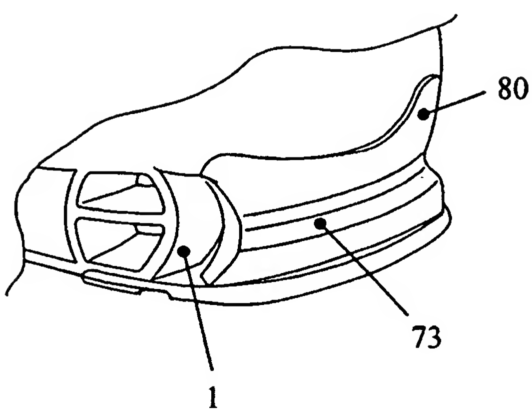



Fig. 15b